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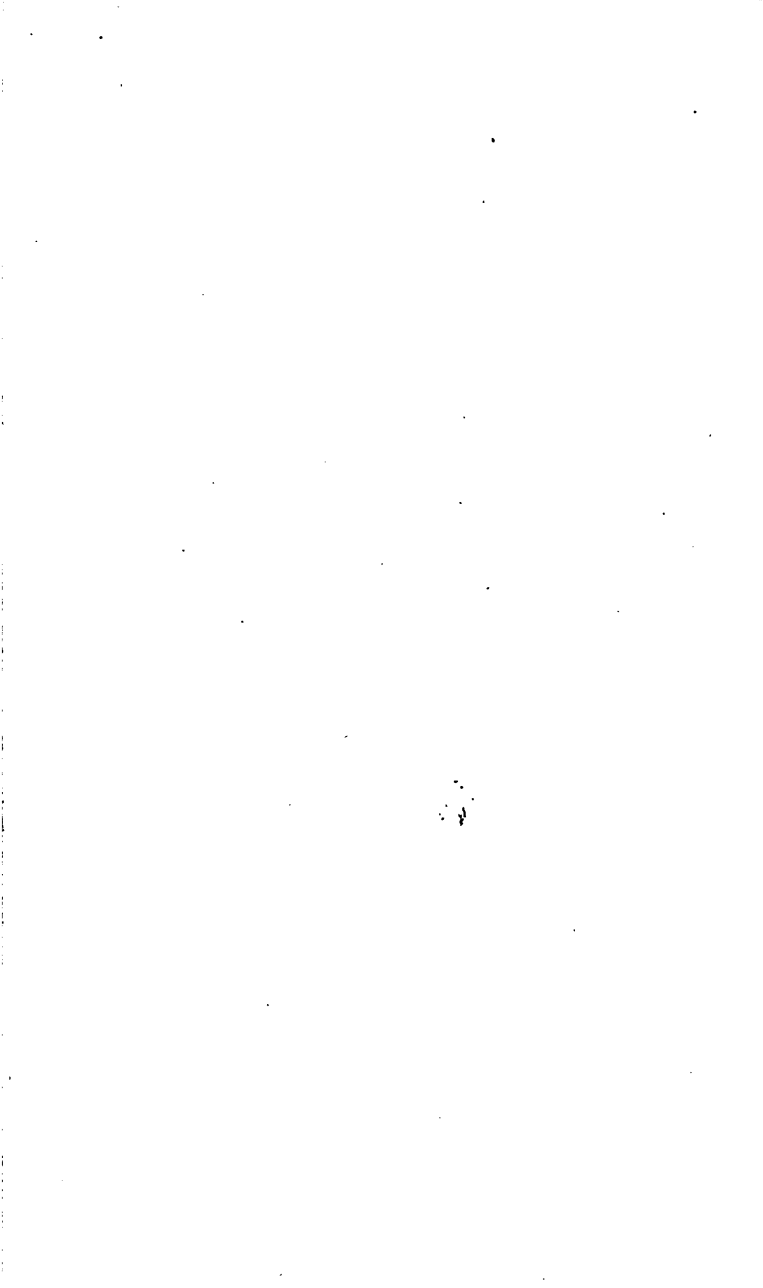
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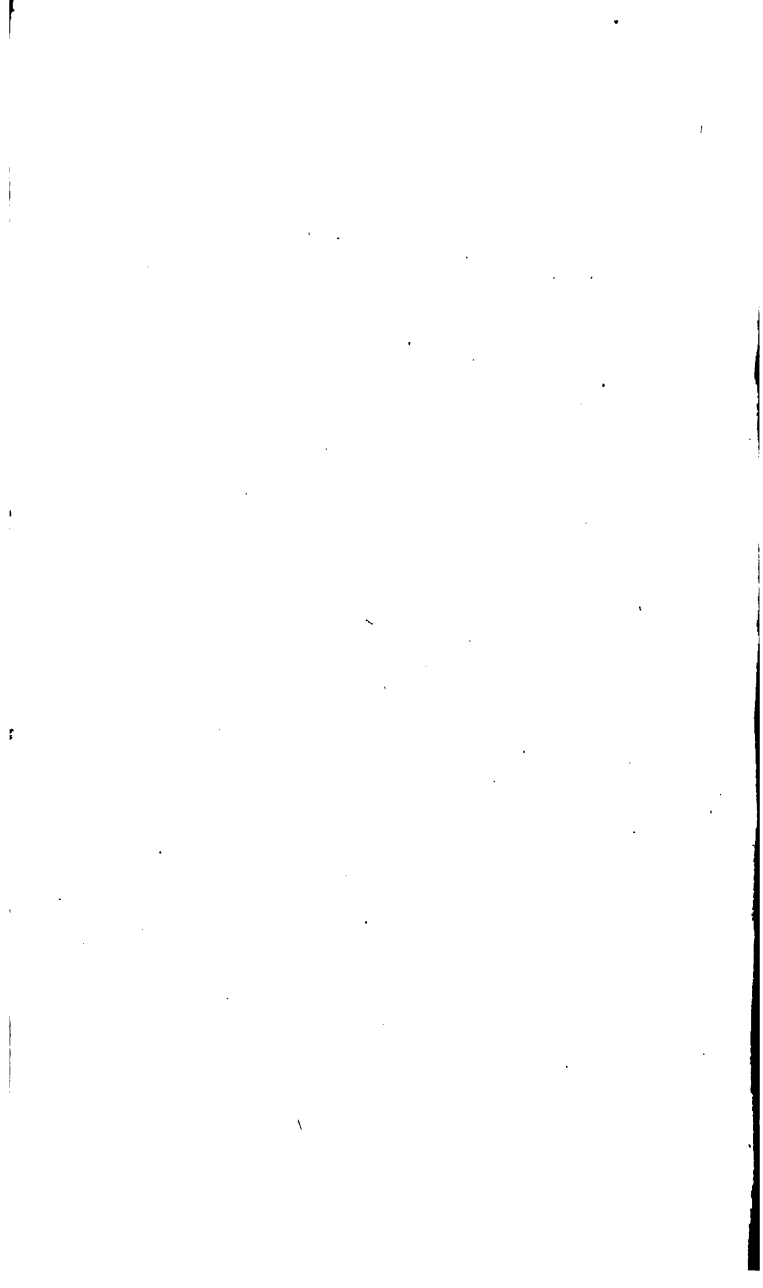
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PUPILS IN PUBLIC AND PRIVATE SCHOOLS.

By JAMES ROBINSON,

AUTHOR OF "THE MERCHANTS', STUDENTS', AND CLERGY'S MANUAL," "THE AMERICAN ARITHMETIC;" AND "THE AMERICAN ELEMENTARY ARITHMETIC."

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P R E F A C E .

THE "Intellectual Multiplier" is designed to furnish pleasing and useful mental exercises for pupils in public and private schools.

A very little practice will enable pupils to answer all the questions in each article promptly, also to solve all similar questions rapidly and correctly, which will be of great practical use in a variety of calculations.

The contractions, in multiplying by numbers larger than 129, are useful, and furnish interesting exercises for mental training. The correctness of these contractions may be verified by multiplying in the usual manner.

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INTELLECTUAL MULTIPLIER.

ART. 1.—*To multiply any number by itself, or by any other number, from 10 to 19 inclusive.*

The product of any two numbers from 10 to 19, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by 10, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 10; to this product add the product of the units.

1. What is the product of 12 multiplied by 12?

Annexing a cipher to any number multiplies it by 10 — thus, $15 \times 10 = 150$.

Solution. $12 + 2 = 14 \times 10 = 140 + 2 \times 2 = 144$.

2. $11 \times 15 = 165$. $11 + 5 = 16 \times 10 = 160 + 1 \times 5 = 165$.

$18 \times 16 = 288$. $18 + 6 = 24 \times 10 = 240 + 8 \times 6 = 288$.

3. $15 \times 19 = 285$. $15 + 9 = 24 \times 10 = 240 + 5 \times 9 = 285$.

4. $19 \times 19 = 361$. $19 + 9 = 28 \times 10 = 280 + 9 \times 9 = 361$.

5. What is the product of 17 multiplied by 13?

6. What is the value of 14 pounds of coffee at 16 cents a pound?

7. What is the product of 14 multiplied by 18?

8. A lady purchased 12 yards of ribbon at 17 cents a yard; what did it cost?

9. Multiply 15 by 14. Multiply 16 by 18.

10. Purchased 18 yards of sheeting at 18 cents a yard ; what did it cost ?

SUGGESTION. Teachers should propose a variety of similar questions, and require their pupils to perform them mentally and orally, with facility and correctness, before proceeding to Article 2.

ART. 2.—*To multiply any number by itself, or by any other number, from 20 to 29 inclusive.*

The product of any two numbers from 20 to 29, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier ; multiply the sum by 2, and the product by 10 ; to this product add the product of the units.

1. What is the product of 25 multiplied by 24 ?

Solution. $25 + 4 = 29 \times 2 = 58 \times 10 = 580 + 5 \times 4 = 600.$

2. $26 \times 26 = 676.$ $26 + 6 = 32 \times 2 = 64 \times 10 = 640 + 6 \times 6 = 676.$

3. $27 \times 29 = 783.$ $27 + 9 = 36 \times 2 = 72 \times 10 = 720 + 7 \times 9 = 783.$

4. What is the value of 23 pounds of butter at 26 cents a pound ?

5. Multiply 22 by 23. Multiply 27 by 21.

6. What will 28 yards of cloth cost at 24 cents a yard ?

7. Multiply 27 by 25. Multiply 24 by 29.

8. Multiply 21 by 27. Multiply 29 by 26.

9. Purchased 25 pounds of tea at 25 cents a pound ; what did it cost ?

SUGGESTION. Pupils should be able to multiply any number by the same, or by any other number, from 20 to 29 inclusive, rapidly and correctly, before proceeding to Article 3.

ART. 3.—*To multiply any number by itself, or by any other number, from 30 to 39 inclusive.*

The product of any two numbers from 30 to 39, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 3, and the product by 10; to this product add the product of the units.

1. What is the product of 33 multiplied by 32?

Solution. $33 + 2 = 35 \times 3 = 105 \times 10 = 1050 + 3 \times 2 = 1056.$

2. What is the product of 35 multiplied by 37?

$35 + 7 = 42 \times 3 = 126 \times 10 = 1260 + 5 \times 7 = 1295.$

3. Purchased 36 bushels of oats at 38 cents a bushel; what was the cost?

4. Multiply 32 by 31. Multiply 33 by 34.

5. Multiply 34 by 35. Multiply 37 by 36.

6. A lady bought a piece of silk, measuring 32 yards, at 37 cents a yard; what did she pay for it?

7. Multiply 34 by 39. Multiply 38 by 34.

8. Multiply 35 by 35. Multiply 39 by 39.

9. What will 36 pair of gloves cost at 37 cents a pair?

SUGGESTION. Each pupil of the class, in succession, should be required to propose similar questions, for the other pupils of the class to solve, with rapidity and correctness.

ART. 4.—*To multiply any number by the same, or by any other number, from 40 to 49 inclusive.*

The product of any two numbers from 40 to 49, is equal to the product of the multiplicand, increased by the units

1056 1295 1260 1295

of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 4, and the product by 10; to this product add the product of the units.

1. What is the product of 44 multiplied by 44?

Solution. $44 + 4 = 48 \times 4 = 192 \times 10 = 1920 + 4 \times 4 = 1936$.

2. What is the product of 49 multiplied by 45?

$49 + 5 = 54 \times 4 = 216 \times 10 = 2160 + 9 \times 5 = 2205$.

3. What will 45 pounds of tea come to at 45 cents a pound?

4. Multiply 42 by 41. Multiply 43 by 46.

5. Multiply 44 by 45. Multiply 47 by 48.

6. What must I pay for 45 yards of silk at 48 cents a yard?

7. Multiply 43 by 45. Multiply 46 by 49.

8. Multiply 49 by 48. Multiply 43 by 49.

9. A trader purchased 45 yards of gingham at 45 cents a yard; what was the amount of his purchase?

SUGGESTION. Each pupil should be called upon, promiscuously, to propose questions, similar to those above, for the other pupils of the class to solve, both mentally and orally.

ART. 5.—*To multiply any number by the same, or by any other number, from 50 to 59 inclusive.*

The product of any two numbers from 50 to 59, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier;

multiply the sum by 5, and the product by 10; to this product add the product of the units.

1. What is the product of 55 multiplied by 55?

Solution. $55 + 5 = 60 \times 5 = 300 \times 10 = 3000 + 5 \times 5 = 3025$.

2. What is the product of 56 multiplied by 58?

$56 + 3 = 59 \times 5 = 295 \times 10 = 2950 + 6 \times 3 = 2968$.

3. Multiply 52 by 51. Multiply 53 by 54.

4. Multiply 54 by 57. Multiply 55 by 56.

5. A provision dealer purchased 58 bushels of potatoes at 56 cents a bushel; what was the amount of his purchase?

6. Multiply 57 by 55. Multiply 55 by 58.

7. Bought 54 pair of shoes at 56 cents a pair; what was the cost of the 54 pair?

8. Multiply 58 by 57. Multiply 59 by 59.

9. A boy can earn 50 cents a day; how much can he earn in 56 days?

ART. 6.—*To multiply any number by the same, or by any other number, from 60 to 69 inclusive.*

The product of any two numbers from 60 to 69, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 6, and the product by 10; to this product add the product of the units.

1. What is the product of 64 multiplied by 62?

Solution. $64 + 2 = 66 \times 6 = 396 \times 10 = 3960 + 4 \times 2 = 3968$.

2. What is the product of 64 multiplied by 64?
 $64 + 4 = 68 \times 6 = 408 \times 10 = 4080 + 4 \times 4 = 4096.$
3. Multiply 61 by 63. Multiply 64 by 61.
4. Multiply 63 by 64. Multiply 65 by 66.
5. What must I pay for 66 yards of silk at 62 cents a yard?
6. Multiply 68 by 65. Multiply 67 by 68.
7. If a bushel of corn is worth 65 cents, what is the value of 65 bushels?
8. Multiply 68 by 69. Multiply 69 by 69.
9. If a bushel of apples is worth 60 cents, what is the value of 64 bushels?

ART. 7.—*To multiply any number by the same, or by any other number, from 70 to 79 inclusive.*

The product of any two numbers from 70 to 79 is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier ; multiply the sum by 7, and the product by 10 ; to this product add the product of the units.

1. What is the product of 72 multiplied by 72?

Solution. $72 + 2 = 74 \times 7 = 518 \times 10 = 5180 + 2 \times 2 = 5184.$

2. What is the product of 74 multiplied by 73?

$74 + 3 = 77 \times 7 = 539 \times 10 = 5390 + 4 \times 3 = 4402.$

3. Multiply 72 by 71. Multiply 73 by 74.

4. Multiply 76 by 75. Multiply 75 by 77.

5. If a First-Class Book cost 75 cents, what will 72 such books cost?

6. Multiply 78 by 77. Multiply 79 by 75.
7. If a pair of gloves be worth 75 cents, what is the value of 75 pair?
8. Multiply 79 by 77. Multiply 78 by 79.
9. When potatoes are 75 cents a bushel, what is the value of 70 bushels?

ART. 8.—*To multiply any number by the same, or by any other number, from 80 to 89 inclusive.*

The product of any two numbers from 80 to 89, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 8, and the product by 10; to this product add the product of the units.

1. What is the product of 85 multiplied by 84?

Solution. $85 + 4 = 89 \times 8 = 712 \times 10 = 7120 + 5 \times 4 = 7140.$

2. What is the product of 84 multiplied by 83?

$84 + 3 = 87 \times 8 = 696 \times 10 = 6960 + 4 \times 3 = 6972.$

3. If a bushel of rye is worth 80 cents, what are 85 bushels worth?

4. Multiply 83 by 86. Multiply 87 by 84.

5. Multiply 88 by 87. Multiply 89 by 88.

6. If a yard of alpaca is worth 85 cents, what are 85 yards worth?

7. Multiply 89 by 84. Multiply 87 by 86.

8. Multiply 88 by 88. Multiply 89 by 89.

9. If a yard of cassimere is worth 88 cents, what is the value of 86 yards?

ART. 9.—*To multiply any number by the same, or by any other number, from 90 to 99 inclusive.*

The product of any two numbers from 90 to 99, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 9, and the product by 10; to this product add the product of the units.

1. What is the product of 95 multiplied by 95?

Solution. $95 + 5 = 100 \times 9 = 900 \times 10 = 9000 + 5 \times 5 = 9025$.

2. What is the product of 94 multiplied by 93?

$94 + 3 = 97 \times 9 = 873 \times 10 = 8730 + 4 \times 3 = 8742$.

3. Multiply 92 by 91. Multiply 93 by 94.

4. Multiply 94 by 95. Multiply 97 by 96.

5. Purchased 96 yards of silk at 90 cents a yard; what was the cost of the 96 yards?

6. Multiply 96 by 94. Multiply 97 by 98.

7. Purchased 96 pear trees at 90 cents each; what did the 96 trees cost?

8. Multiply 99 by 98. Multiply 99 by 99.

9. If a yard of cloth is worth 90 cents, what is the value of 99 yards?

ART. 10.—*To multiply any number by itself, or by any other number, from 100 to 109 inclusive.*

The product of any two numbers from 100 to 109, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 100; to this product add the product of the units.

1. What is the product of 102 multiplied by 102?

Solution. $102 + 2 = 104 \times 10 = 1040 \times 10 = 10400 + 2 \times 2 = 10404.$

2. What is the product of 104 multiplied by 103?

$104 + 3 = 107 \times 10 = 1070 \times 10 = 10700 + 4 \times 3 = 10712.$

3. Multiply 105 by 104. Multiply 106 by 105.

4. Multiply 107 by 106. Multiply 108 by 107.

5. If one square foot of land is worth 108 cents, what is the value of 106 square feet?

6. Multiply 109 by 107. Multiply 108 by 108.

7. If a yard of doeskin cloth is worth 108 cents, what will 105 yards cost?

8. Multiply 109 by 108. Multiply 109 by 109.

9. What will 108 pairs of chickens cost, at 106 cents per pair?

ART. 11.—*To multiply any number by the same, or by any other number, from 110 to 119 inclusive.*

The product of any two numbers from 110 to 119, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 11 and the product by 10; to this product add the product of the units.

1. What is the product of 115 multiplied by 115?

Solution. $115 + 5 = 120 \times 11 = 1320 \times 10 = 13200 + 5 \times 5 = 13225.$

2. What is the product of 114 multiplied by 112 ?

$114 + 2 = 116 \times 11 = 1276 \times 10 = 12760 + 4 \times 2 = 12768.$

3. Multiply 111 by 113. Multiply 116 by 114.

4. Multiply 116 by 115. Multiply 117 by 115.

5. What is the value of 112 yards of cloth at 110 cents a yard?

6. Multiply 118 by 116. Multiply 117 by 113.

7. Sold 112 bushels of apples for 112 cents a bushel; what was the sum of money received?

8. Multiply 119 by 117. Multiply 119 by 119.

9. Sold 118 bushels of beans at 110 cents per bushel; how many dollars did I receive for the 118 bushels?

ART. 12.—*To multiply any number by itself, or by any other number, from 120 to 129 inclusive.*

The product of any two numbers from 120 to 129, is equal to the product of the multiplicand, increased by the units of the multiplier, multiplied by the tens of the multiplier, plus the product of the units.

To the multiplicand add the unit figure of the multiplier; multiply the sum by 12, and the product by 10; to this product add the product of the units.

1. What is the product of 125 multiplied by 125?

Solution. $125 + 5 = 130 \times 12 = 1560 \times 10 = 15600 + 5 \times 5 = 15625.$

2. What is the product of 124 multiplied by 122?

$124 + 2 = 126 \times 12 = 1512 \times 10 = 15120 + 4 \times 2 = 15128.$

3. Multiply 123 by 121. Multiply 124 by 126.

4. Multiply 127 by 125. Multiply 123 by 126.

5. Sold 125 cwt. of hay at 120 cents per cwt.; what was the sum of money received for the hay?
6. Multiply 127 by 127. Multiply 128 by 128.
7. A farmer sold 124 bushels of wheat for 125 cents per bushel; what number of dollars did he get for the 124 bushels?
8. Multiply 127 by 129. Multiply 129 by 129.
9. A farmer sold 120 barrels of apples for 125 cents per barrel; what number of dollars did he receive?

ART. 13.—*To find the product of any two numbers less than 130.*

The product of any two numbers is equal to the product of the tens multiplied by the tens, plus the product of the tens in each of the numbers multiplied by the units of the other, plus the product of the units.

1. What is the product of 36 multiplied by 25?

Solution. $30 \times 20 = 600 + 30 \times 5 + 20 \times 6 = 870 + 6 \times 5 = 900.$

2. What is the product of 26 multiplied by 24?
3. What is the product of 32 multiplied by 22?
4. What is the product of 45 multiplied by 36?
5. What is the product of 48 multiplied by 32?
6. What is the value of 24 bushels of corn at 65 cents a bushel?
7. What is the value of a piece of cloth, measuring 25 yards, at 25 cents a yard?
8. What is the product of 43 multiplied by 23?
9. What is the product of 61 multiplied by 51?
10. A farmer sold 72 bushels of potatoes at 45 cents a bushel; how much did he receive for them?

ART. 14.—*To find the product of any number multiplied by itself, less than 130.*

NOTE. The product of any number multiplied by itself is called the square, or second power, of that number.

The square of any number is equal to the square of the tens, plus twice the product of the tens multiplied by the units, plus the square of the units.

1. What is the product of 125 multiplied by 125 ?

Solution. $120 \times 120 = 14400 + 120 \times 5 \times 2 = 15600 + 5 \times 5 = 15625$.

2. What is the square, or second power, of 13, 14, 15, 16, 17, 18, and 19 ?

3. What is the square, or second power, of 24, 25, 26, 27, and 28 ?

4. What is the square, or second power, of 32, 43, 54, 65, and 76 ?

5. Purchased 124 square feet of land at 124 cents a square foot ; what did it cost me ?

6. What is the value of 94 bushels of rye at 94 cents a bushel ?

ART. 15.—*To find the square of any number, less than 130, whose unit figure is 5.*

The square of any given number is equal to the product of two other numbers, one of which is as much greater than the given number as the other is less, plus the square of half the difference of the two numbers.

1. What is the product of 15 multiplied by 15 — or square of 15 ?

Solution. $20 \times 10 = 200 + 5 \times 5 = 225$.

2. What must I pay for 25 pounds of butter at 25 cents a pound?

Solution. $30 \times 20 = 600 + 5 \times 5 = 625$ cents, or \$6.25.

3. What is the square of 35?

4. What is the square of 45?

5. What is the square of 55?

6. What is the square of 65?

7. What is the value of 75 acres of land at 75 dollars an acre?

8. Purchased 85 bushels of apples at 85 cents a bushel; what was the cost of them?

9. If a bushel of wheat is worth 125 cents, what is the value of 125 bushels?

ART. 16.—*To find the product of any two unequal numbers, less than 130, whose sum and difference are even numbers.*

The product of any two unequal numbers, whose sum and difference are even numbers, is equal to the square of half their sum, minus the square of half their difference.

1. What is the product of 25 multiplied by 15?

Solution. $25 + 15 = 40 \div 2 = 20 \times 20 = 400 - 5 \times 5 = 375$.

2. Purchased 24 yards of sheeting at 16 cents a yard; what was the cost of the 24 yards?

Solution. $24 + 16 = 40 \div 2 = 20 \times 20 = 400 - 4 \times 4 = 384$ cents, or \$3.84.

3. What is the product of 35 multiplied by 25?

4. What is the product of 45 multiplied by 35?

5. What is the product of 36 multiplied by 24?

6. What is the product of 48 multiplied by 32?

7. What is the value of 36 bushels of oats at 44 cents a bushel?

8. If a boy can earn 42 cents in a day, how much can he earn in 38 days?

9. What is the value of 85 yards of silk at 75 cents a yard?

ART. 17.—*To find the second power, or square, of any mixed number whose fractional part is $\frac{1}{2}$.*

The square of any mixed number, whose fractional part is $\frac{1}{2}$, is equal to the product of the multiplicand plus $\frac{1}{2}$, multiplied by the integral part of the multiplier, plus the square of $\frac{1}{2}$.

1. What is the square of $5\frac{1}{2}$?

Solution. $5\frac{1}{2} + \frac{1}{2} = 6 \times 5 = 30 + \frac{1}{2} \times \frac{1}{2} = 30\frac{1}{4}$.

2. What is the square of $16\frac{1}{2}$?

Solution 1. $16\frac{1}{2} + \frac{1}{2} = 17 \times 16 = 272 + \frac{1}{2} \times \frac{1}{2} = 272\frac{1}{4}$.

“ 2. $16\frac{1}{2} + \frac{1}{2} = 17 + 6 = 23 \times 10 = 230 + 7 \times 6 = 272 + \frac{1}{2} \times \frac{1}{2} = 272\frac{1}{4}$.

3. If a horse can trot $9\frac{1}{2}$ miles in one hour, how many miles can he trot in $9\frac{1}{2}$ hours?

4. What is the value of $15\frac{1}{2}$ yards of gingham at $15\frac{1}{2}$ cents a yard?

5. Multiply $25\frac{1}{2}$ by $25\frac{1}{2}$. Multiply $44\frac{1}{2}$ by $44\frac{1}{2}$.*

6. What is the square of $96\frac{1}{2}$?

7. What is the square of $105\frac{1}{2}$?

8. What is the value of $112\frac{1}{2}$ yards of cassimere at $112\frac{1}{2}$ cents a yard?

9. What is the value of $125\frac{1}{2}$ square feet of land at $125\frac{1}{2}$ cents a foot?

* See Article 18.

ART. 18.—*To find the product of two unequal mixed numbers, when the fractional part of each is $\frac{1}{2}$?*

The product of two unequal mixed numbers is equal to the product of the whole numbers, plus $\frac{1}{2}$ of the sum of the whole numbers, plus the product of the fractions.

1. What is the product of $5\frac{1}{2}$ multiplied by $3\frac{1}{2}$?

Solution. $5 \times 3 = 15 + 4 = 19 + \frac{1}{2} \times \frac{1}{2} = 19\frac{1}{4}$.

2. What is the product of $9\frac{1}{2}$ multiplied by $4\frac{1}{2}$?

Solution. $9 \times 4 = 36 + 6\frac{1}{2} = 42\frac{1}{2} + \frac{1}{2} \times \frac{1}{2} = 42\frac{3}{4}$.

3. What is the product of $7\frac{1}{2}$ multiplied by $5\frac{1}{2}$?

4. What is the product of $10\frac{1}{2}$ multiplied by $9\frac{1}{2}$?

5. What is the value of $16\frac{1}{2}$ pounds of coffee at $12\frac{1}{2}$ cents a pound?

6. Purchased $24\frac{1}{2}$ pounds of tea at $37\frac{1}{2}$ cents a pound; what did it cost? *

7. What is the product of $48\frac{1}{2}$ multiplied by $36\frac{1}{2}$?

8. What is the product of $95\frac{1}{2}$ multiplied by $75\frac{1}{2}$?

9. What is the number of square feet in the floor of a hall $124\frac{1}{2}$ feet in length, and $105\frac{1}{2}$ feet in width?

10. What must I pay for $129\frac{1}{2}$ bushels of wheat at $125\frac{1}{2}$ cents per bushel?

ART. 19.—*To find the product of two mixed numbers, the whole numbers of which are the same, and the sum of the fractions is 1.*

Multiply one of the whole numbers, plus 1, by the other, and to the product add the product of the fractions.

1. What is the product of $3\frac{3}{4}$ multiplied by $3\frac{1}{4}$?

Solution. $4 \times 3 = 12 + \frac{3}{4} \times \frac{1}{4} = 12\frac{3}{16}$.

* See Article 18.

2. What is the product of $12\frac{1}{2}$ multiplied by $12\frac{1}{2}$?

Solution. $12 + 1 = 13 \times 12 = 156 + \frac{1}{2} \times \frac{1}{2} = 156\frac{1}{4}$.

3. What is the product of $4\frac{2}{3}$ multiplied by $4\frac{1}{3}$?

4. What is the product of $7\frac{1}{2}$ multiplied by $7\frac{1}{2}$?

5. What is the product of $9\frac{1}{2}$ multiplied by $9\frac{1}{2}$?

6. What is the product of $110\frac{1}{2}$ multiplied by $110\frac{1}{2}$?

7. What is the value of $11\frac{1}{2}$ pounds of beef at $11\frac{1}{2}$ cents a pound?

8. What is the cost of $12\frac{3}{4}$ pounds of coffee at $12\frac{3}{4}$ cents a pound?

9. Bought a piece of sheeting, measuring $15\frac{1}{2}$ yards, at $15\frac{1}{2}$ cents a yard; what did it cost me?

10. What is the value of $124\frac{1}{2}$ dozen arithmetics at $124\frac{1}{2}$ cents a dozen?

ART. 20.—*To find the second power, or square, of any number whose unit figure is 5.*

The second power, or square, of any number whose unit figure is 5, is equal to the square of the number of tens in the given number, plus the square of 5.

1. What is the square of 125?

Solution. $125 = 12\frac{1}{2}$ tens, and $12\frac{1}{2}$ tens \times $12\frac{1}{2}$ tens $= 13$ tens \times 12 tens $= 15600 + 5 \times 5 = 15625$.

2. What is the second power, or square, of each of the following numbers: 15, 25, 35, 45, 55, 65, 75, 85, 95, 105, and 115?

3. What is the second power, or square, of each of the following numbers: 135, 145, 155, 165, 175, 185, and 195?

4. What is the number of square feet in a square room, each of the 4 sides measuring 15 feet in length?

5. There is a square pavement, each side of which measures 25 yards in length; what number of square yards does it contain?

ART. 21.—*To find the product of any two mixed numbers whose fractional parts are the same.*

The product of two mixed numbers, whose fractional parts are the same, is equal to the product of the whole numbers, plus such a fractional part of the sum of the two numbers as is indicated by one of the fractions, plus the product of the fractions.

1. What is the product of $8\frac{1}{4} \times 4\frac{1}{4}$?

Solution. $8 \times 4 = 32 + \frac{1}{4}$ of $8 + 4 = 35 + \frac{1}{4} \times \frac{1}{4} = 35\frac{1}{16}$.

2. What is the product of $9\frac{1}{3} \times 6\frac{1}{3}$?

Solution. $9 \times 6 = 54 + \frac{1}{3}$ of $9 + 6 = 59 + \frac{1}{3} \times \frac{1}{3} = 59\frac{1}{9}$.

3. What is the product of $12\frac{1}{2} \times 7\frac{1}{2}$?

Solution. $12 \times 7 = 84 + \frac{1}{2}$ of $12 + 7 = 93\frac{1}{2} + \frac{1}{2} \times \frac{1}{2} = 93\frac{3}{4}$.

4. What is the product of

$$\begin{array}{lll} 5\frac{3}{8} \times 4\frac{3}{8} ? & 4\frac{1}{8} \times 3\frac{1}{8} ? & 8\frac{3}{8} \times 6\frac{3}{8} ? \\ 8\frac{3}{8} \times 6\frac{3}{8} ? & 10\frac{5}{8} \times 8\frac{5}{8} ? & 9\frac{5}{8} \times 7\frac{5}{8} ? \\ 9\frac{5}{8} \times 7\frac{5}{8} ? & 11\frac{7}{8} \times 9\frac{7}{8} ? & 12\frac{7}{8} \times 10\frac{7}{8} ? \end{array}$$

5. What is the value of $11\frac{3}{8}$ pounds of sugar, at $8\frac{3}{8}$ cents a pound?

ART. 22.—*To find the second power, or square, of any mixed number whose fractional part is $\frac{1}{4}$.*

The second power, or square, of any mixed number whose fractional part is $\frac{1}{4}$, is equal to the square of the whole number, plus $\frac{1}{2}$ of itself, plus the square of $\frac{1}{4}$.

1. What is the second power, or square, of $5\frac{1}{4}$?

Solution. $5 \times 5 = 25 + \frac{1}{2}$ of $5 = 27\frac{1}{2} + \frac{1}{4} \times \frac{1}{4} = 27\frac{9}{16}$.

2. What is the square of $6\frac{1}{4}$? of $8\frac{1}{4}$?
3. What is the square of $7\frac{1}{4}$? of $9\frac{1}{4}$?
4. What is the square of $10\frac{1}{4}$? of $12\frac{1}{4}$?

ART. 23.—*To find the second power, or square, of any mixed number whose fractional part is $\frac{3}{4}$.*

The square of any mixed number whose fractional part is $\frac{3}{4}$, is equal to the square of the whole number, plus $\frac{3}{2}$ of itself, plus the square of $\frac{3}{4}$.

1. What is the square of $5\frac{3}{4}$?

Solution. $5 \times 5 = 25 + \frac{3}{2}$ of 5 = $32\frac{1}{2} + \frac{3}{4} \times \frac{3}{4} = 33\frac{1}{8}$.

2. What is the square of $6\frac{3}{4}$? of $8\frac{3}{4}$?
3. What is the square of $7\frac{3}{4}$? of $9\frac{3}{4}$?
4. What is the square of $10\frac{3}{4}$? of $12\frac{3}{4}$?

ART. 24.—*To multiply one number by another, containing two or more figures each, and write the product in a single line.*

Illustration, 1. Let it be required to multiply 45 by 32, and to write the product in a single line.

45		We first multiply 5 by 2; the product is 10;
32		we write down the 0, and reserve the 1. Then
—		4×2 , + 1 we reserved, + $5 \times 3 = 24$; we write
1440		down the 4 and reserve the 2. Then 4×3 ,
		+ 2 we reserved, = 14; the whole of which
		we write down, and the product is completed.

It is obvious that this is the usual method, with the intermediate steps of the operation performed mentally.

2. We will now multiply 456 by 345.

The first and second figures of the product are found as before. To find the third, 4×5 , + 5 which was reserved,

<div style="display: flex; align-items: center;"> <div style="text-align: right; padding-right: 10px;"> 456 345 <hr style="width: 100px; border: 0.5px solid black;"/> 157320 </div> <div> $+ 6 \times 3 + 5 \times 4 = 63$; we write down the 3, and reserve the 6. Then we drop the unit figures, and multiply the hundreds and tens crosswise, as we did the tens and units, thus : $4 \times 4, + 6$ we reserved, $+ 5 \times 3 = 37$; we write down the 7, and reserve the 3. Then dropping both the tens and units, we multiply 4 by 3, and add the 3 we reserved to the product, and we have 15; the whole of which we write down, and the product is completed. </div> </div>
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The same principle may be extended to any number of places, but each successive step should be made perfectly familiar before advancing to another.

1. Multiply 8642 by 5432.

ART. 25. — “The following method of multiplying by large numbers in a single line, is both curious and useful.”

Multiply 7865 by 432 in a single line.

“On a slip of paper, separate from that on which the multiplicand is written, write the multiplier in an inverted order, thus: 234, and close to the upper edge of the paper. Then bring the multiplier so that the 2 shall be directly under the 5, or units' place of the multiplicand. Multiply 5 by 2; write down 0, and reserve the 1. Slide the paper one place to the left, so that the 2 may be under the 6, and 3 under 5; and to the products of 6×2 and $5 \times 3, + 1$ we reserved, $= 28$, write down 8, and reserve the 2. Again move the paper one place to the left, and to the several products of the figures of the multiplicand by the figures of the multiplier that are under them, viz: $8 \times 2, 6 \times 3, 5 \times 4, + 2$ we reserved, $= 56$, write down 6, and reserve the 5. Slide the paper again, and you have 7×2

$6 \times 4, 8 \times 3, + 2$ we reserved, $= 67$. Thus proceed towards the left until the multiplier passes from under the multiplicand, each time adding the tens you reserve to the several products; the result will be 3397680. These additions will soon be performed at a glance, as the products are obvious without the formality of naming the factors.

"To understand these directions clearly, the factors must be placed upon slips of paper, and the directions strictly complied with; by which the mode of operation and the reason will be better understood in ten minutes, than in three hours without them.

"When familiar with the slide, the operator may proceed without it, and perform operations astonishing to the uninitiated; one large number being multiplied by another with facility, and the total product written in a single line."

1. Multiply 432 by 23. 2. Multiply 5432 by 432.
3. What is the product of 86543 multiplied by 6543?
4. What is the product of 975432 multiplied by 865432?

ART. 26.—"Contractions in multiplication serve to show the powers and properties of numbers, and to amuse and exercise the faculties of the student; and in many instances they are practically useful; but contractions should not be resorted to unless they are perfectly understood in theory and in mode of operation.

"Persons who practise mental calculation to much extent find abbreviations very necessary, and generally adopt such as suit their convenience best. Some of the following may be practically convenient, and all of them may be worth the student's study, as a further means of familiarizing the subject to his mind."

1. To multiply any number by 25, annex two ciphers to the number, and divide the product by 4.

Thus, $3969 \times 25 = 99225$ product.

$$\begin{array}{r} 4)396900 \\ \hline \end{array}$$

99225 product.

This is in effect to multiply by 100, and to take one fourth of the product, which is the same as to multiply by 25, the fourth of 100.

2. On the same principle, annex one cipher and divide by 2, to multiply by 5.

3. To multiply by $12\frac{1}{2}$, annex two ciphers and divide by 8.

4. To multiply by 125, annex three ciphers and divide by 8.

5. To multiply by $33\frac{1}{3}$, annex two ciphers and divide by 3.

6. To multiply by $333\frac{1}{3}$, annex three ciphers and divide by 3.

7. To multiply by $16\frac{2}{3}$, annex two ciphers and divide by 6.

This principle may be applied in multiplying by any number that is a measure of 10, 100, 1000, 10000, &c.

8. To multiply by 99, annex two ciphers and subtract the given number from the result.

Multiply 31416 by 99.

$$\begin{array}{r} 3141600 \\ \hline \end{array}$$

$$\begin{array}{r} 31416 \\ \hline \end{array}$$

3110184 product.

As 99 times is 1 time less than 100 times, and annexing two ciphers is in effect multiplying by 100; 1 time the multiplicand is deducted, which leaves 99 times, as required.

9. To multiply by any number of 9's, annex as many

ciphers to the multiplicand as there are 9's in the multiplier, subtract the multiplicand from this product, the remainder is the product required.

Multiply 888888 by 9999. $8888880000 - 888888 = 8887991112$, product.

ART. 27.—*To multiply by any number between 10 and 20.*

Multiply by the unit figure only of the multiplier, and write the product under the multiplicand, one place to the right; then add the product to the multiplicand; the sum is the product required. The reason is evident on looking at the operation.

1. What is the product of 3854 multiplied by 15?

$$3854 \times 15$$

$$19270$$

$$57810 \text{ Answer.}$$

2. What is the product of 98765 multiplied by 18?

ART. 28.—*To multiply by 21, 31, 41, 51, 61, 71, 81, or 91; also by the same figures with any number of ciphers between them.*

Multiply by the left-hand figure only of the multiplier, and write the unit figure of the product under the multiplicand, one place to the left, and as many places farther as there are ciphers between the significant figures; then add the product to the multiplicand; the sum will be the product required.

1. 73918×21 2. 56934×301 3. 46532×5001

$$147836$$

$$170802$$

$$1552278 \text{ prod.}$$

$$17137134 \text{ prod.}$$

$$4. \quad 68045 \times 90001$$

ART. 29.—*To multiply by any number between 10 and 20, and write the product in a single line.*

Multiply by the unit figure of the multiplier, and to the product of each figure, except the first, add the figure in the multiplicand next on the right of the one multiplied; and add the tens in the product of the last figure to the last figure of the multiplicand, and write the sum at the left of the other figures of the product.

1. What is the product of 45632×15 ?

15

684480 Answer.

2. What is the product of 94653×18 ?

ART. 30.—*To multiply by any number between 100 and 110, and write the product in a single line.*

Multiply by the unit figure of the multiplier, and to the product of each figure, after the second, add the second of the multiplicand, on the right of the one multiplied; and write the last two figures of the multiplicand, plus the tens of the product of the last figure, at the left of the other figures of the product.

1. What is the product of 65432×105 ?

105

6870360 Answer.

4. What is the product of 987654×109 ?

MISCELLANEOUS QUESTIONS.

1. What will be the cost of 12 yards of cloth at 15 cents a yard?
2. When butter is worth 24 cents a pound, what is the value of a firkin containing 25 pounds?
3. If the price of a gallon of molasses is 32 cents, what must I pay for a barrel containing 36 gallons?
4. What is the value of 45 bushels of oats at 42 cents a bushel?
5. If a boy can earn 56 cents in one day, how many dollars can he earn in 55 days?
6. At 67 cents a yard, what is the value of a piece of carpeting measuring 65 yards?
7. What is the value of 72 yards of cassimere at 75 cents a yard?
8. At 85 cents a bushel, what must I pay for 88 bushels of rye?
9. What is the value of 96 bushels of potatoes at 92 cents a bushel?
10. What must I pay for 108 bushels of apples at 105 cents a bushel?
11. What is the number of square feet in a lot of land 118 feet long and 112 feet wide?
12. What is the value of 128 bushels of wheat at 125 cents a bushel?

13. What is the value of a piece of silk measuring 45 yards, at 45 cents a yard?
14. What is the product of 125 multiplied by 125?
15. What is the square, or second power, of 129?
16. What is the product of 48 multiplied by 32?
17. What is the product of 96 multiplied by 72?
18. What is the product of 112 multiplied by 108?
19. What is the product of 105 multiplied by 95?
20. What is the product of 125 multiplied by 115?
21. What is the value of $12\frac{1}{2}$ dozen of eggs at $12\frac{1}{2}$ cents a dozen?
22. What must a lady pay for $15\frac{1}{2}$ yards of gingham at $15\frac{1}{2}$ cents a yard?
23. What is the value of $7\frac{1}{4}$ tons of coal at $7\frac{1}{4}$ dollars a ton?
24. What is the square, or second power, of $15\frac{3}{4}$?
25. What is the value of $25\frac{3}{4}$ acres of land at $25\frac{3}{4}$ dollars an acre?

To multiply numbers mentally, between 12 and 100, by any number not exceeding 12, always multiply the higher order first; because the figures are thus taken in their natural order, and in practice it will be found to be more easy and convenient.

26. A man drove 8 oxen to market, and sold 4 of them for 64 dollars apiece; what did he receive for them?

4 times 60 are 240, and 4 times 4 are 16, added to 240, are 256. Answer, 256 dollars.

He sold the remaining 4 oxen for 72 dollars apiece; what did he get for them?

4 times 70 are 280, and 4 times 2 are 8, added to 280, are 288. Answer, 288 dollars.

27. A merchant purchased 75 barrels of flour at 8 dollars a barrel; how many dollars did it cost?

28. A man travelled on a railroad 9 days; he travelled 96 miles each day; how many miles did he travel in the 9 days?

29. If one acre of ground produce 45 bushels of corn, how many bushels would grow on 11 acres?

30. If there are 99 families in a town, and each family consumes 12 cords of wood annually, how many cords are used in the town each year?

To multiply numbers between 100 and 1000, a similar method may be conveniently applied.

31. What is the value of 525 barrels of flour at 9 dollars a barrel?

9 times 500 are 4500, 9 times 20 are 180, added to 4500 are 4680; and 9 times 5 are 45, added to 4680 are 4725. Answer, 4725 dollars.

32. What is the value of a farm containing 324 acres, at 12 dollars an acre?



27
 21
 27
 54
 567

27x21-28 28050

27x21-28 280

27x21-28 560-

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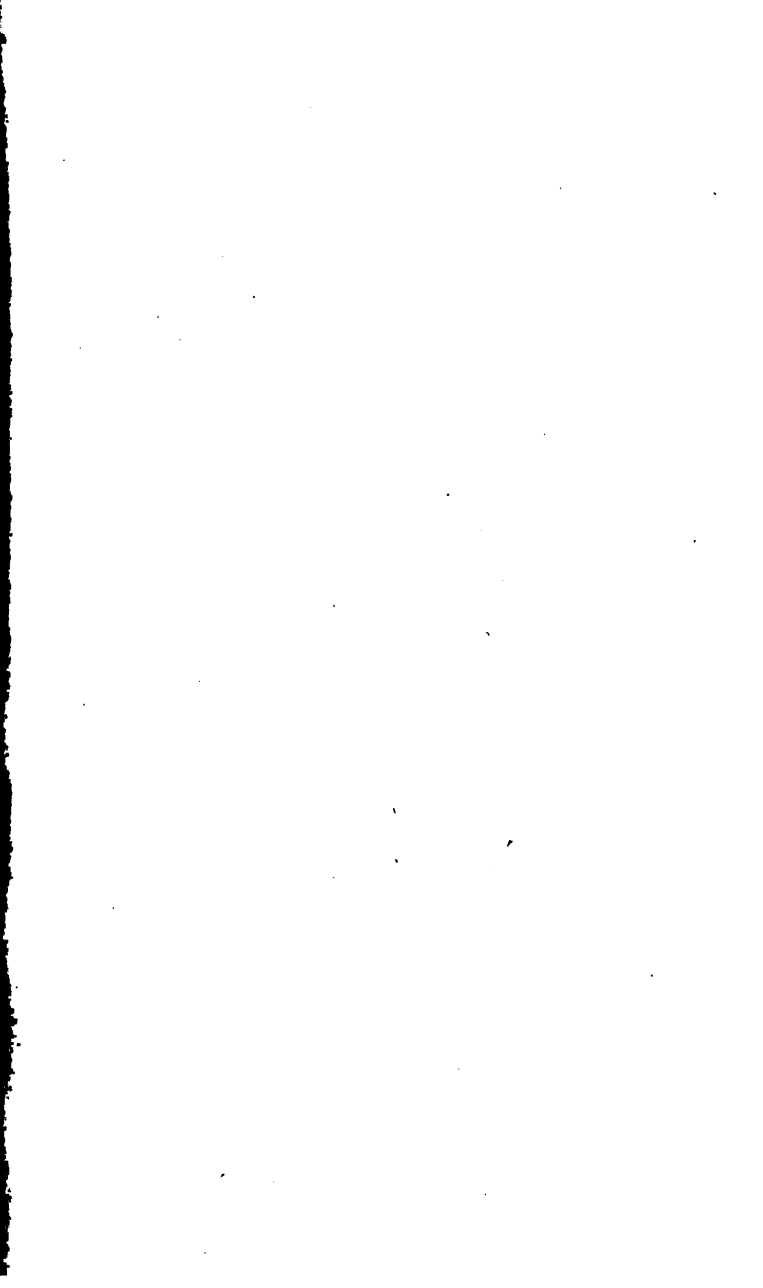
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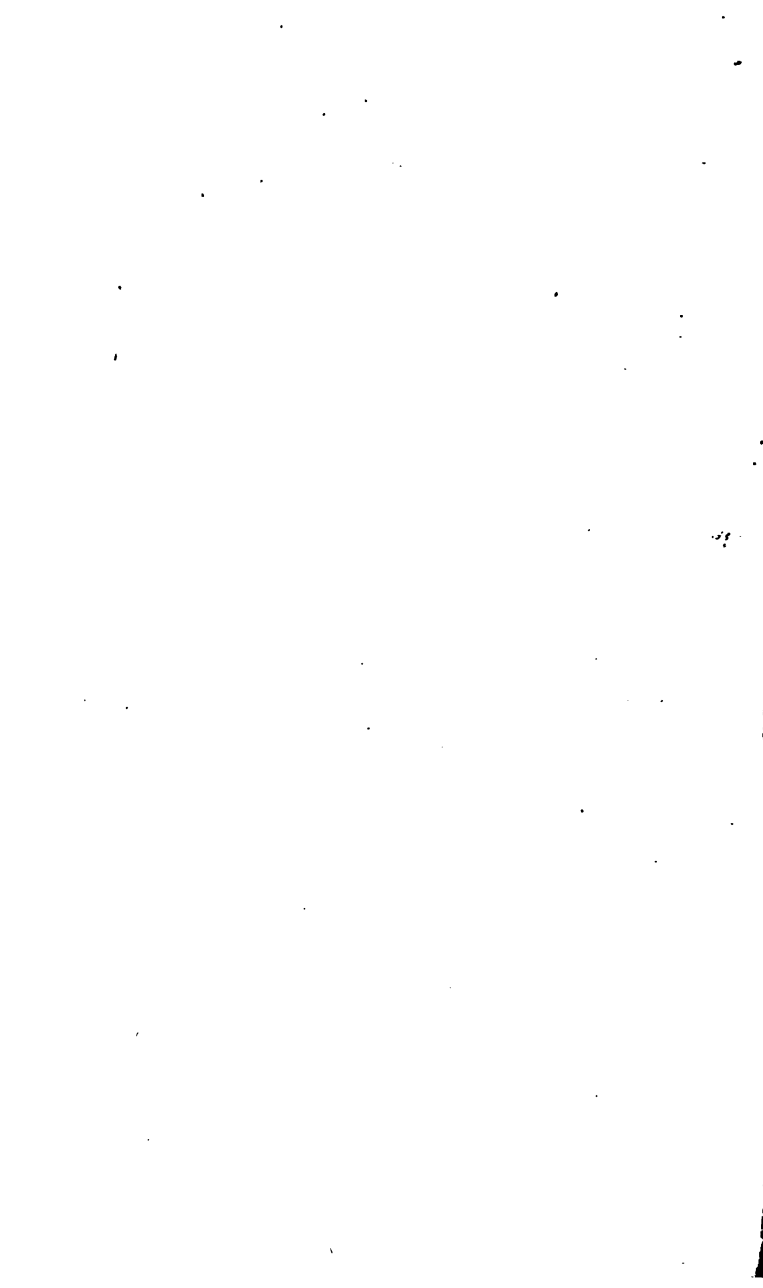
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